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Transcranial magnetic stimulation, tinnitus and auditory hallucinations

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Transcranial magnetic stimulation (TMS) has been shown to be effective in modulating cerebral cortex activity. Most of the published controlled studies have reported that left temporoparietal area stimulation with 1 Hz frequencies has managed to improve auditory hallucinations at least partially and transiently in patients suffering from schizophrenia. These stimulation parameters have been demonstrated to be useful in otologic patients with tinnitus sensation. The clinical relevance of these findings has already been discussed. However, in spite of the clinical benefit of TMS for these or other patients, it is revealing new data and new questions about the neurobiological basis of mental disorders. For example: which is the common substrate in tinnitus and auditory hallucinations that could explain such a therapeutic coincidence? In this work we present two representative clinic cases and we discuss this question.

Key words:

Transcranial magnetic stimulation. Auditive hallucinations. Tinnitus.

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Estimulación magnética transcraneal, tinnitus y alucinaciones auditivas

La estimulación magnética transcraneal (EMT) se ha demostrado capaz de modular la actividad de la corteza cerebral. La estimulación del área temporoparietal izquierda con frecuencias de 1 Hz ha conseguido mejorar, al menos de forma parcial y transitoria, las alucinaciones auditivas de pacientes con esquizofrenia en la mayoría de los estudios controlados publicados. Lo mismo podemos decir de dichos parámetros de estimulación aplicados a pacientes otológicos con sensación de tinnitus. Se discute todavía la relevancia clínica de estos hallazgos. Sin embargo, aparte del beneficio clínico que pueda aportar en un futuro la EMT a estos u otros pacientes,

nos está aportando nuevos datos y nuevas preguntas sobre las bases neurobiológicas de los trastornos mentales. Por ejemplo: ¿qué tienen en común el tinnitus y las alucinaciones auditivas para semejante coincidencia terapéutica? En este trabajo se presentan dos casos clínicos ilustrativos y se discute acerca de la pregunta formulada.

Palabras clave:

Estimulación magnética transcraneal. Alucinaciones auditivas. Tinnitus.

INTRODUCTION

TMS is a relatively new neurobiological tool that we are still learning how to use¹. It has aroused many expectations in Psychiatry, although the clinical relevance of its results is still debatable². Schizophrenia has been investigated most after the field of depression. Two lines of research have been followed the most. The first is the possibility of improving the negative symptoms, applying high frequency TMS (neuronal activator) on the left prefrontal level³. The second is the improvement of antipsychotic treatment resistant auditory hallucinations with low frequency TMS (neuronal inhibitor) on the left temporoparietal level⁴. This second option is that which provides the best results, although not all the studies coincide⁵.

Patients with acuphenes or tinnitus experience sounds or noises originating in their head without justifying external stimuli. This is a frequent problem that affects from 1% to 3% of the population⁶. When it becomes chronic and is sufficiently intrusive, it can become invalidating and generate suffering. Treatment of the most severe cases is general unsatisfactory⁷. Anxiety and depression pictures and suicide are relatively frequent complications. Functional neuroimaging studies have demonstrated that tinnitus is associated to regional cortical hyperactivation⁸. The capacity of the low frequency TMS to reduce cortical excitability explains why there are already several studies in which improvement of patients with tinnitus using said technique is demonstrated⁶. In the following we present two clinical cases that are illustrative of that explained up to now.

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COMMON METHODOLOGY TO THE TWO CASES

The patients were informed on the objectives of the study and the possible side effects of the technique before they signed the written informed consent. The treatment they had been receiving was maintained unchanged for one month prior to the onset of the study and during it. The TMS sessions were made with DANTEC equipment (Dantec Medical, Medtronic Inc., Minneapolis, MN), MagLite model, and we downloaded the equipment from a PC in which the MagTrig program had been installed. We used a figure-of-eight coil and each wing measured 8.5 cm. in diameter. The principal stimulation parameters were: 34 pulse trains at 100% of threshold, of 60 second duration, with a frequency of 1 Hz and with 2 seconds of interval between pulse trains. The stimulation site was the left temporoparietal area, exactly in the middle point of the line joining the P2 and T2 points of the electroencephalographic 10-20 system of electrode registry. The motor threshold was determined in the left motor area by means of the search for the most selective response of the right thumb abduction. The coil was placed tangentially to the scalp, with the handle pointing at 45° regarding the middle sagittal line. TMS was well tolerated by both patients. Both suffered mild muscular activation of the muscles of the left hemiface due to the stimulation of the facial and trigeminal nerve endings.

SYNTHETIC DESCRIPTION OF BOTH CASES

Case 1

A 26 year old woman diagnosed of schizophrenic disorder since more than 3 years ago. She suffers auditory hallucinations resistant to antipsychotic psychodrug treatment that generate intense malaise. She was taking ziprasidone 180 mg/day for more than one month. Prior, she had taken olanzapine and risperidone at full doses, also without result. She just finished a therapeutic program in day hospital regimen, also without improvement of her hallucinatory picture. Due to all this, it was proposed that she undergo a therapeutic test with TMS, which she accepted. The patient reported a subjective improvement in her hallucinations at the end, in both frequency and in intensity. The score on the Psyrats evaluation of auditory hallucinations scale went from 25 to 9. At one month of completing the sessions cycle, she manifested that the hallucinations had become worse again

Case 2

A 73 year old woman with tinnitus for more than 30 years that gradually began after an ear intervention. She perceives a constant noise having high frequency during the entire day in both ears, worse in the right one. Intensity was evaluated at 90 over 100. None of the treatments received up to now have helped her (last trimetazidine 60 mg). She presented an associated anxiety-depressive

syndrome that was justified on the basis of the limitations and suffering generated by her disease. She scored 15 on the 17-item Hamilton depression scale. After 3 weeks, after receiving a 10 session cycle of TMS, the patient reported less intense acuphenes and, above all, one that was much more tolerable. The score was 50 over 100. In addition, she was more cheerful and less anxious. The Hamilton score was 8. At the end of one month, the patient began to suffer tinnitus again with the same intensity and associated malaise as before the TMS.

DISCUSSION

There are many and varied neuropsychiatric diseases in which improvements have been reported that are attributed to low frequency transcranial magnetic stimulation: depression, Parkinson's disease, dystonia, neurogenic pain, epilepsy, as well as tinnitus and schizophrenia⁹. It was suggested in all of the previous cases that TMS could be capable of reverting an unbalance in cerebral activity related with clinical semiology⁴. However, it should be stressed that the improvements reported in the best of the cases were partial and transitory as occurred in both of the patients we present. In any event, attention is called to the fact that the same parameters of TMS applied in the auditory cortex have been effective in such different clinical pictures. It is true that the neurobiological bases of tinnitus and auditory hallucinations have not been clarified. However, some coinciding findings have been reported that make us think that there may be some relationship. For example, in functional neuroimaging tests, an increase of the activity in the language areas associated to perception of auditory hallucinations has been verified, similar to that seen with tinnitus¹⁰. On the other hand, it has been proposed that ear diseases are a risk factor for both tinnitus and auditory hallucinations, and that they may coexist with greater frequency than to be expected by chance¹¹. However, the possibility that the auditory hallucinations experienced by the patients who suffer tinnitus are the same as those experienced by psychotic patients has been refuted¹². Finally, it has been proposed that patients with hallucinations and tinnitus, as epileptic and Parkinsonian patients, suffer a self-sustained aberrant and focal cerebral activity originated by uncontrolled positive neuronal feedback^{4,13-17}. In the coming years, we will see if the TMS methodology can be improved by focally modulating the neuronal excitability in a more complete and maintained way in time, with comparable safety and tolerability. If this occurs, it is likely that we will be able to offer new therapeutic alternatives to patients in great need of them¹⁹.

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